

April 2014

INTELLIGENT CAR PARKING SYSTEM

S. AVINASH

*R V College of Engineering, R V Vidyaniketan Post Office RVCE, Mysore Road, Bengaluru,
Karnataka-560059, s.avinash@gmail.com*

Follow this and additional works at: <https://www.interscience.in/ijcsi>



Part of the [Computer Engineering Commons](#), [Information Security Commons](#), and the [Systems and Communications Commons](#)

Recommended Citation

AVINASH, S. (2014) "INTELLIGENT CAR PARKING SYSTEM," *International Journal of Computer Science and Informatics*: Vol. 3 : Iss. 4 , Article 9.

Available at: <https://www.interscience.in/ijcsi/vol3/iss4/9>

This Article is brought to you for free and open access by Interscience Research Network. It has been accepted for inclusion in International Journal of Computer Science and Informatics by an authorized editor of Interscience Research Network. For more information, please contact sritampatnaik@gmail.com.

INTELLIGENT CAR PARKING SYSTEM

S. AVINASH¹, SNEHA MITTRA², SUDIPTA NAYAN GOGOI³ & C. SURESH⁴

^{1,2,3&4}R V College of Engineering, R V Vidyaniketan Post Office
RVCE, Mysore Road, Bengaluru, Karnataka-560059

Abstract - Due to the proliferation in the number of vehicles on the road, traffic problems are bound to exist. This is due to the fact that the current transportation infrastructure and car parking facility developed are unable to cope with the influx of vehicles on the road. In India, the situation are made worse by the fact that the roads are significantly narrower compared to the west. Therefore problems such as traffic congestion and insufficient parking space inevitably crops up. In his paper we describe an Intelligent Car Parking System, which identifies the available spaces for parking using sensors, parks the cars in an identified empty space and gets the car back from its parked space without the help of any human personnel. A Human Machine Interface (HMI) helps in entering a unique identification number while entry of any car which helps in searching for the space where the car is parked while exit. An Indraconrol L10 PLC controls the actions of the parking system. The PLC is used to sequence the placing and fetching of the car via DC motors. We have implemented a prototype of the system. The system evaluation demonstrates the effectiveness of our design and implementation of car parking system.

Keywords - Proximity sensor, Infrared sensor, DC motor, Programmable Logic Controller.

I. INTRODUCTION

The Intelligent Car Parking System is being designed for developing a user friendly, intelligent and automated car parking system which greatly reduces manpower, land area for parking, fuel consumption of the vehicle and reduces carbon emissions.

A few existing studies focused on the applications of car parking system using sensor technologies. Few systems adopt cameras to collect the information in car parking field. However, a video sensor has two disadvantages; one is that a video sensor is energetically expensive and the other is that a video sensor can generate a very large amount of data which can be very difficult to transmit in a wireless network. These greatly limit the application of video sensor. The system in [1] adopts wireless sensors in a car park field and each parking lot is equipped with one sensor node, which detects and monitors the occupation of the parking lot.

The status of the parking field which is detected by sensor nodes is reported periodically to a database via the deployed wireless sensor network and its gateway. The database can be accessed by the upper layer management system to perform various management functions, such as finding vacant parking lots, auto-toll, security management, and statistic report. The system in [2] adopts vision based system which is able to detect and indicate the available parking spaces in a car park. The methods utilized to detect available car park spaces were based on coordinates to indicate the regions of interest and a car classifier. The work done indicated that the application of a vision based car park management system would be able to detect and indicate the available car park spaces.

Unlike the above ideas, where it is only aimed at finding out the vacant car parking space, the idea of making a prototype of an Intelligent Car Parking System was thought of, where this system would identify the available spaces for parking using sensors, park the cars in an identified empty space and gets the car back from its parked space without the help of any human personnel.

In this system it is required to sense empty space and the respective floor where the car can be parked. This could be done with the help of sensors so; various sensors that are available are temperature sensor, Infrared sensor, UV sensor, Touch sensor, proximity sensor, bio sensor, image sensor and acceleration sensor. Thus, for finding the floor in which the empty space is present, Infrared sensors are used as it emits and /or detects infrared radiation to sense a particular phase in the environment. It is easy to interface and is readily available in the market. Now, for sensing the empty space in a particular floor, proximity sensors are used as it detects the presence of objects that are nearly placed without any point of contact.

This system also required a motor for the movement of the mechanical arm which would be placing and fetching the car. The motors that are available are DC motors and stepper motors. So, it was thought of using DC motor as, DC Motors have several advantages over stepper motors. When it comes to speed, weight, size, cost, DC motors are always preferred over stepper motors. The direction of rotation of motor can be controlled, so, the encoding of the rotation can be made by DC motor i.e. keeping track of how many turns are made by the motors etc. Stepper motors jerks when it rotates. So it can be seen that DC motors are better than stepper motors. Thus

two DC motors are used, one for vertical movement of the mechanical arm and the other one for the clockwise and counter clockwise rotation of the mechanical arm. The two way rotation of the DC motor is achieved by using the L293D dual motor driver circuit.

This system also required a controller to control the functions of the whole system. The various types of controller's are Microcontroller, PIC microcontroller, micro processor and Programmable Logic Controllers. So, Programmable logic controller (PLC) is chosen as it is easy for technical's to be dealing with ladder logic more than C or assembly or other programming language. The ladder logic is a very simple way of interfacing it like turning motors on and off based on a set of inputs. In PLC the logic is obvious and easily modifiable. PLCs more suitable for industrial applications, they can bear the dust and hits.

Based on this Literature Survey, the idea adopted for the project entitled "Intelligent Car Parking System" was to use Infrared Sensors instead of wireless sensors as it is of low cost, readily available, proximity sensor, DC motor instead of stepper motor and Programmable Logic Controller.

II. REQUIREMENT ANALYSIS

In this section, we describe the requirements of designing an intelligent car parking system. Although the conventional requirements of a car parking system can be easily satisfied. In the following we list, some important requirements of a car parking system.

The common goal for all car parks is to attract more drivers to use their facilities from the business aspect. Thus, their basic facilities are required to fulfill the following conventional requirements:

- (a) The location of the car park should be easy to find in the street.
- (b) The entrance of the car park should be easy to discover.
- (c) The number of parking lots should be abundant.
- (d) A parking lot should obtain a large space enough to park a car in.
- (e) Easy to exit and re enter on foot.

However an intelligent car parking system should provide more convenience and automation to both the business and the customers. It should also satisfy the following requirements:

- (a) It should have a compact structure, Low cost of ownership and simple; user friendly safe

retrieval process prevents damage to vehicles.

- (b) It should provide environmental protection by reducing vehicular emissions and general energy savings.
- (c) It should provide safety of vehicle by preventing damages or dents to the car are avoided while parking through narrow drive ways.
- (d) It should easily accommodate all types of car's and SUV'S.

In accordance with the above requirements, an intelligent car parking system should minimize human operations and supervisions, so as to reduce the manpower and the loss from human mistakes. Also, the car park system is required to provide higher accuracy, robustness and flexibility in operations, more convenience to customers, lower cost of operating and maintaining overall system.

III. DESIGN AND IMPLEMENTATION

In this section we describe the design of the Intelligent Car Parking System which deals with the sensors and relay circuits and then the motor control unit.

1. Sensors and Relay Circuits

Electronic components used in the structure enable complete control and management of the car parking system. Various sensors are used to find out each empty space along with the floor in which the empty space is present.

1.1 Proximity Sensor

A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact. It often emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. The object being sensed is often referred to as the proximity sensor's target [3].

The system consists of two floors for parking cars hence, eight proximity sensors are being used, four in each floor. The voltage range of each proximity sensor is 5 to 12 V and sensitivity range varies from 10mm to 50mm. The proximity sensors are used for detecting the presence and absence of a car parked in each parking space of each floor. It continuously emits infrared rays and checks for an empty space. This acts as an input to the Programmable Logic Controller which in turn helps in the placing and fetching of cars. The Figure 1.1 shows the proximity sensor.

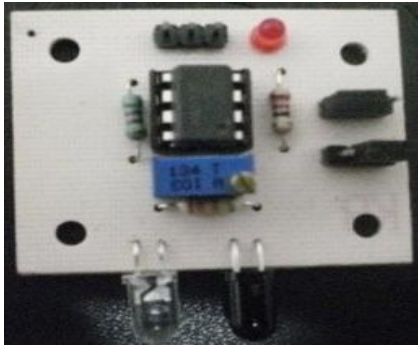


Fig. 1.1 : Proximity sensor.

1.2 Infrared Transmitter

Infrared led is used for the purpose of detection. The system consists of twenty-one Infrared Transmitters [4]. Thin sheet metal strips are placed behind each car park space and one behind the place where the driver is asked to keep the car i.e., in the ground floor. Behind each car park space and in front of each floor, two Infrared Transmitters are placed at a vertical distance of 4cm. These are shorted so that they start emitting at the same time in case of a free space available.

A single Infrared Transmitter is placed in the ground floor which continuously emits until the receiver receives it. This is done so that the mechanical arm can detect the presence of a car which has arrived for parking. Two Infrared Transmitters are used for each floor. While fetching a car from its parked space, the first (the one below the floor) Infrared Transmitter is turned on whereas while placing a car, the second (the one above the floor) Infrared Transmitter is turned on.

In case of placing a car, an empty space is searched by the proximity sensor and then its respective IR Transmitter and floor transmitter is turned on, which together guides the arm movement and helps in placing the car. The Figure 1.2 shows the Infrared Transmitter.



Fig. 1.2 : Infrared Transmitters

1.3 Relay Panel Board

A relay is a kind of switch which is controlled by an electric current. A relay panel board is used instead of adding a mains switching relay. It is a commercially manufactured circuit board fitted with a relay, LED indicator, back EMF preventing diode, and easy to use screw-in terminal connections [5].

In the system, three 12V and 250v/10 Amp AC, 8 relay boards are being used to switch the low

voltage IR sensors output voltage to the 24 V DC which will be used by the programmable logic controller. The Figure 1.3 shows the Relay Panel Board.

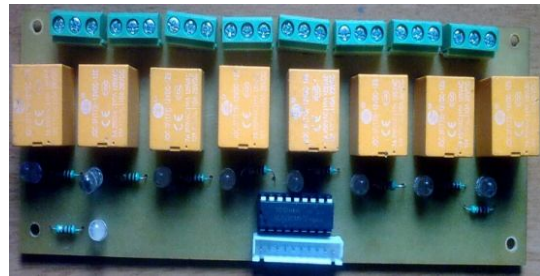


Fig. 1.3 : Relay Panel Board

1.4 Voltage Divider Circuit

A voltage divider (also known as a potential divider) is a linear circuit that produces an output voltage (V_{out}) that is a fraction of its input voltage (V_{in}). Voltage division refers to the partitioning of a voltage among the components of the divider [6].

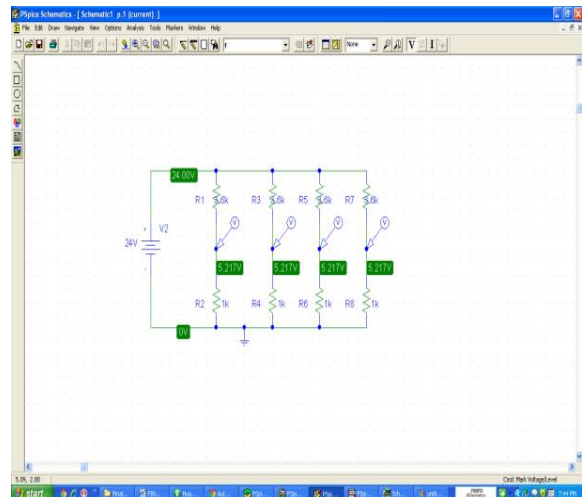


Fig. 1.4 : Voltage Divider Circuit

In this system, a voltage divider circuit is required for converting the output voltage of 24 V of the PLC to a voltage of nearly 5V which is used by the sensor. The output of the voltage divider circuit is found out by simulating it in PSPICE simulator as shown in Figure 1.4.

2. Motor Control Unit

Electrical components which are primarily used are the standard DC Motors that help in accomplishing the motion of the mechanical arm. The DC Motor used in the system is of 12 V DC. DC motors are controlled using Indracontrol L10 PLC.

2.1 Main Controller Board

Indracontrol L10 Programmable Logic Controller (PLC) serves as the Intelligent Car Parking System's "brain", controlling and managing all the functions of the car parking system. The Indracontrol L10 Programmable Logic Controller that is used in the

system operates on a 24 V DC supply which is in built in it. A Human Machine Interface is used in this system for entering an unique identification number while entry and exit of a car. The communication port that is being used in the system is Ethernet. To store the program, a SanDisk firmware flash card is used [7].

2.2 DC Motor

A DC motor is an electric motor that runs on direct current (DC) electricity [9]. Two Standard DC Motors are being used in this system. The DC Motors performs the task of moving the mechanical arm in the clockwise and counter clockwise and vertical direction for the placing and fetching of cars. Using the L293D Dual H Bridge converter, the motor is made to rotate in both clockwise and counter clockwise direction.

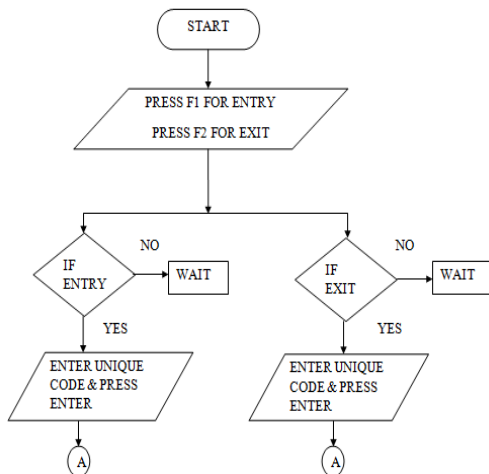
IV. PROGRAMMING AND TESTING

Programming of the system enables its working. Using ladder diagram logic, instructions that collectively define the process of its parts movement are specified and compiled [8]. This logic is subsequently downloaded onto the Programmable Logic Controller, which performs the required motor functions by using the DC motors and the placing and fetching of car by using the mechanical arm. Also essential synchronization of the parts is achieved by the Programmable Logic Controller.

Programming of the system is desired for the following functions:

- 1) To find out an empty space from the inputs of the Proximity sensors.
- 2) To make the transmitter of the corresponding, floor and ground floor turn on.
- 3) To make the DC Motor rotates in both clockwise and anticlockwise motion.

HMI Working
Flowchart 1.1

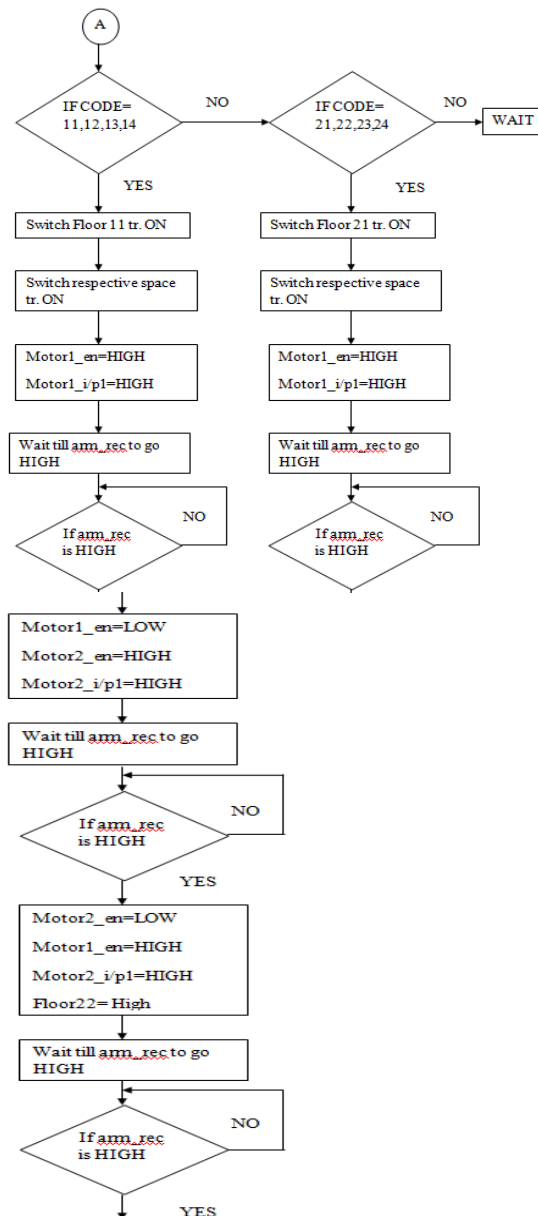


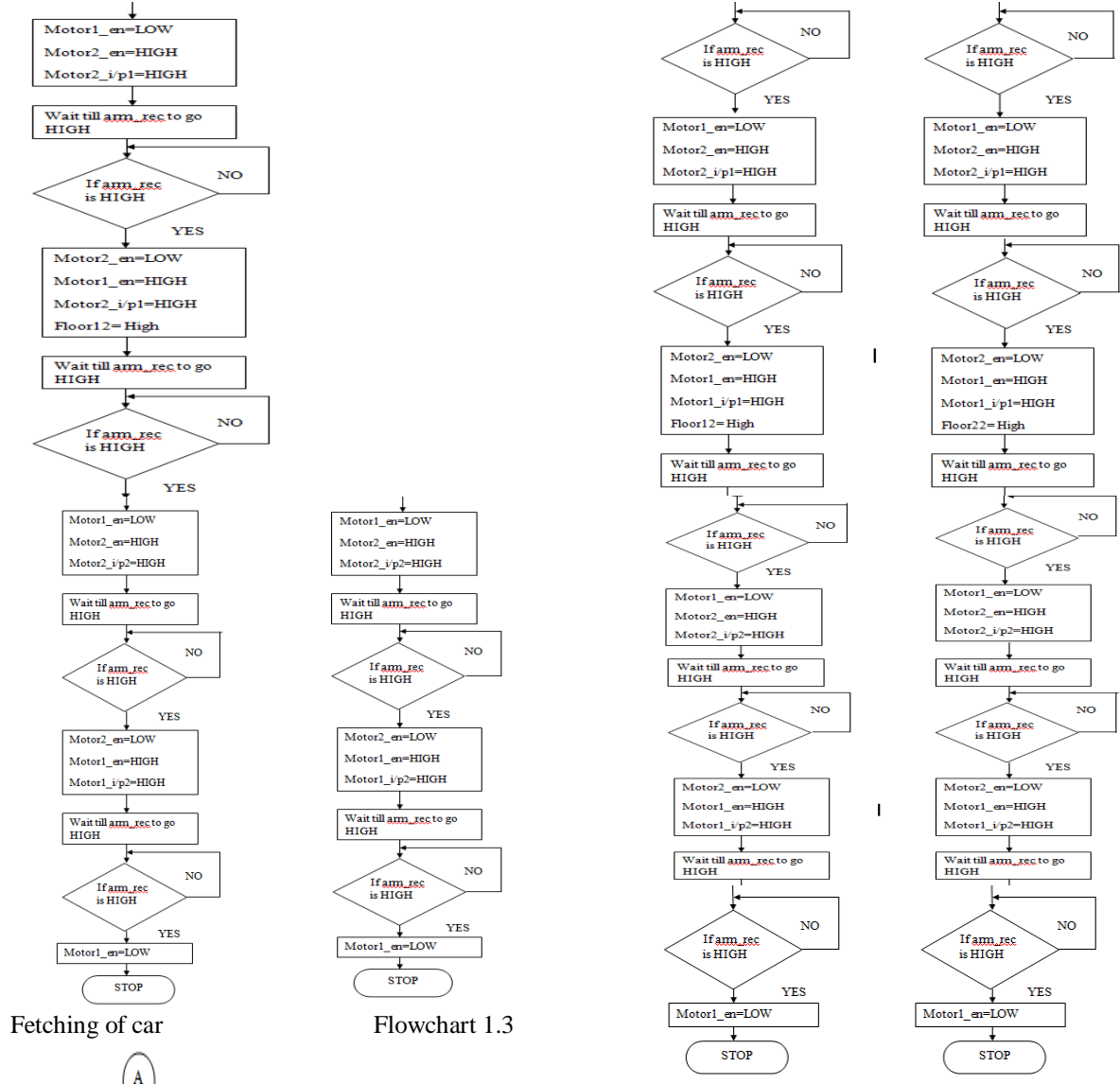
The Flowchart 1.1 explains the operation of Human Machine Interface which will ask the user to press F1

in case of entry and F2 in case of exit. If entry is selected, then the user is asked to enter the given code and in case of exit, the user is asked to enter the unique code.

Placing of a cr
Flowchart 1.2

The Flowchart 1.2 explains the operation while placing a car. If the empty space is first floor then, the first floor's upper transmitter is switched on and the mechanical arm carrying the car is raised till it reaches first floor (detected by arm receiver). Then, the mechanical arm is rotated in anticlockwise direction using second motor simultaneously first motor is switched off. When the arm reaches the respective space, arm is lowered by rotating the first motor in opposite direction and finally car is place and the mechanical arm is brought back to its initial position by controlling both the motors sequentially.

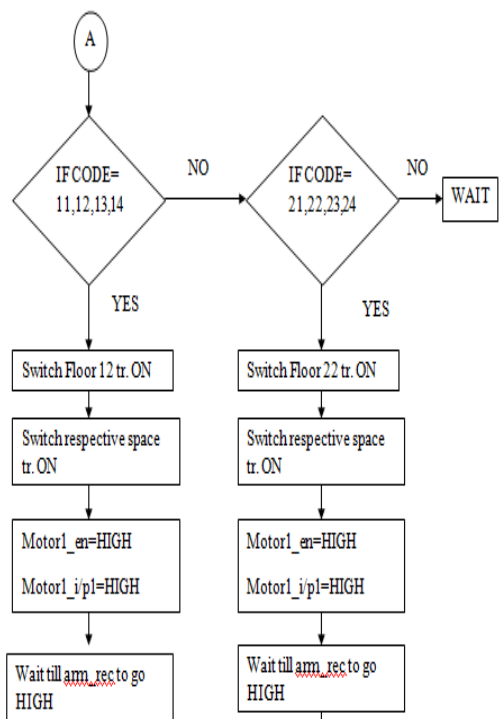




The Flowchart 1.3 explains the operation while fetching a car. If the car to be fetched is in first floor then, the first floor's lower transmitter is switched on and the mechanical arm is raised till it reaches first floor (detected by arm receiver). Then, the mechanical arm is rotated in anticlockwise direction using second motor simultaneously first motor is switched off. When the arm reaches the respective space, arm is raised by rotating the first motor in opposite direction and finally car is brought back to its initial position by controlling both the motors sequentially.

V. RESULTS

For the Intelligent car parking system to work properly, the inputs from the Human Machine Interface was given and hence the following results were obtained. The following figures shows the sequence of operation while placing a car.



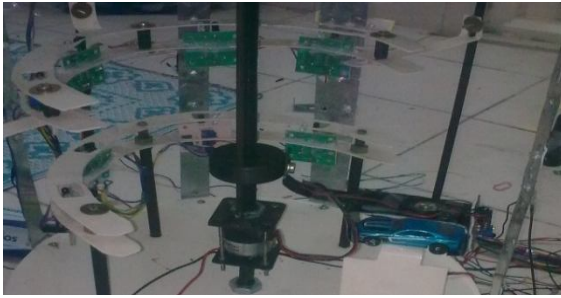


Fig. 1.6 Mechanical arm lifting a car from ground floor

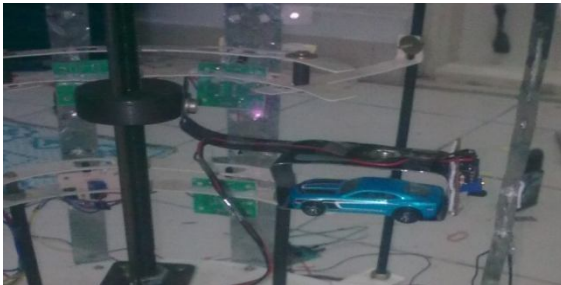


Fig. 1.7 : Mechanical arm receiver sensing the rays from the first floor transmitter



Fig. 1.8 : Mechanical arm rotating in anticlockwise direction for placing car



Fig. 1.9 : Mechanical arm receiver sensing the rays of the empty space transmitter and placing it



Fig. 2.0 : Mechanical arm moving downwards towards the ground floor



Fig. 2.1 : Mechanical arm reaches the ground floor

After entering entry in the HMI and then entering the unique code, it was seen that the mechanical arm lifts the car from the ground floor as shown in Figure 1.6. Then, the mechanical arm starts moving upwards with the help of the screw jack mechanism and the first DC Motor and as soon as the mechanical arm receiver receives the rays from the first floor's transmitter, the arm rotates in anticlockwise direction. The Figure 1.7 shows the mechanical arm sensing the first floor and Figure 1.8 shows the rotation of the mechanical arm for placing the car in an empty space. Then, the mechanical arm receiver senses the rays from the space transmitter and then places the car. This is shown in Figure 1.9. After placing the car, the mechanical arm rotates in clockwise direction and then gets down. This is shown in Figure 2.0. Then, finally, the arm gets back to the ground floor and the motor stops. This is shown in Figure 2.1. Similarly, the fetching of a car operation takes place in the opposite manner.

VI. CONCLUSION AND FUTURE SCOPE

The mechanical model of the Intelligent Car Parking System is compliant to achieving the proper placing and fetching of cars. The model is rigid and is capable of housing and shielding the DC Motors, Proximity sensors, IR transmitters and an IR receiver. Three separate supplies were used in this system, a 24V, 12 V and a 5V supply. The 24V supply powers the L10 Programmable Logic Controller which is in built in it, which acts as the brain of the system, manages and controls all the functions of the system. The DC Motors which are used for the clockwise counter clockwise and vertical up and down movement of the mechanical arm is driven by a 12V supply given from a 12V adapter. The proximity sensors which are used to find out an empty space for placing car is powered by a 5V supply which is given by a 5V adapter.

Detection of parking slot availability is achieved by using proximity sensors. Infrared transmitters and an Infrared Receiver is used for detecting the floor as well as the space which has got an empty space to park a car. Proximity detects the space from where a parked car has to be fetched and brought back to the ground floor. A relay panel board is used for switching the low voltage IR sensors output voltage to the 24 V DC which will be used by the

programmable logic controller and vice-versa and a voltage divider circuit is used for converting the output voltage of 24 V of the PLC to a voltage of nearly 5V which is used by the sensor. The ladder logic diagram developed by using IndraWorks software has been implemented. This logic is downloaded in the firmware flashcard. The Programmable Logic Controller was able to control and manage all the functions of the system such as finding out the empty space from the inputs of the proximity sensors, making the transmitter of the corresponding floor and ground floor turn on and off and also making the DC Motor rotate in both clockwise and anticlockwise direction. The features that can be added to the system are:

- Instead of using the screw jack mechanism, hydraulics can be used for reducing the lifting time.
- Instead of using mechanical arm, fork lift can be used.
- Security system can be added to it.

REFERENCES

- [1] Vanessa W.S. Tang, Yuan Zheng, Jiannong Cao, "An Intelligent Car Park Management System based on Wireless Sensor Networks", 1st International Symposium on Pervasive Computing and Applications, 2006
- [2] Hamada R. H. Al-Absi, Patrick Sebastian, Justin Dinesh Daniel Devaraj, Yap Yooi Yoon, "Vision-Based Automated Parking System", 10th International Conference on Information Science, Signal Processing and their Applications (ISSPA 2010)
- [3] E.L. Dereniak and G. D. Boreman, "Infrared Detectors and Systems", Wiley Series in Pure Optics and Applied Optics, Wiley- Interscience, 1st Edition, April 1999, ISBN-10:0471122092
- [4] John David Vincent, Tom Vincent, "Fundamentals of Infrared Detector Operation and Testing", Wiley- Interscience, 1st Edition, 1990, ISBN 0471502723
- [5] Staley H. Horowitz, Arun G. Padke, "Power System Relaying", John Wiley & Sons Inc., 3rd Edition , 2008, ISBN-10:0470057122
- [6] Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson, 10th Edition, 2009, ISBN 978-81-317-2700-3
- [7] Rexroth Bosch Manual 2011
- [8] Garry Dunning, "Introduction to Programmable Logic Controllers", CENGAGE Learning, 3rd Edition, December 2005, ISBN-10:1401884261
- [9] B. L. Theraja, A. K. Theraja, "A Textbook of Electrical Technology", Sultan Chand & Sons, 1st Multicolour Edition, Volume II, 2005, ISBN 81-219-2437-5

